THE IMPACT OF J. L. BARNARD ON NORTH AMERICAN PACIFIC AMPHIPOD RESEARCH: A TRIBUTE

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ABSTRACT

From 1947 to 1963, and prior to his association with the Smithsonian Institution and move to Arizona, Dr. J. L. (Jerry) Barnard had conducted extensive field surveys on gammaridean amphipod crustaceans and other marine invertebrates along the Pacific coast of California, northern Mexico, and southern Oregon. During this 17-year period, and in the following 28-year period until his death, he published 65 papers on this rich fauna. These encompassed more than 500 regional species of gammarideans of which 213 species, 45 genera, and 2 families were newly proposed. Jerry Barnard pioneered the taxonomic study of the Phoxocephalidae, Ampeliscidae, Megaluropidae, Haustoriidae, Lysianassidae, and other infaunal or sediment-burrowing families, typically with primitive pelagic mating life styles. He also contributed many new names within the Hyalidae, Liljeborgiidae, Melitidae, Isaeidae, Ampithoidae and other "reptant" or bottom-crawling and tube-dwelling families with advanced pre-amplexing mating style. Especially after 1963, his revisionary studies elevated amphipodology to a new plateau of excellence in a region where fewer than 150 gammaridean species had been known previously. Jerry's popular, well-illustrated keys have introduced at least two generations of students to Pacific coast amphipods. His research publications have greatly facilitated the subsequent monographic studies of Hurley and the SCAMIT group of researchers in California, and of numerous workers on amphipods in the Canadian research group, mostly from the more northerly coasts of Washington state, British Columbia, and Alaska. Barnard's contributions continue to provide a solid framework upon which illustrated guides to the known amphipod fauna of the Pacific coast from Alaska to California, of more than 700 species, can be based. His work has had an equally profound and lasting influence on Russian, Japanese, and Chinese investigations on amphipod crustaceans of the entire North Pacific region and world-wide.

INTRODUCTION

When Jim Thomas invited us to take part in the J. L. Barnard memorial symposium in Washington, we were delighted and honoured to do so. One of us (ELB) was able to attend and present orally the essence of the following tribute. Although Jerry and ELB met only occasionally over the years, mainly at scientific meetings, and once in Washington, their correspondence extended over more than 30 years and involved a very broad range of topics in amphipodology. ELB also had the privilege of reviewing some of Jerry's larger manuscripts prior to publication, as well as a few of his NSF research proposals. These included his pioneering work (with Margaret Drummond) on Australian Phoxocephalidae (1978) and part of his two-volume compendium (with Charlene) on freshwater amphipods of the world (1983). Although Jerry did not always incorporate review suggestions, nor the previously published views of some colleagues, his works were characterized by a scholarly attention to detail, a broad comprehensiveness and thoroughness, and overall excellence of presentation. As most amphipodologists know, his views differed on some aspects of this discipline, most notably and strongly on the overall phyletic positioning and classification of gammaridean higher taxa. The correctness of these views on amphipod phylogeny will be decided eventually by our peers and followers, and are not discussed here. Shortly before his death, Jerry and ELB exchanged pleasant philosophical views on the course of amphipod systematics, and on the need to increase scientific emphasis upon, and financial support for, systematic biology in general. Dr. Barnard had been very helpful to members of our Canadian working group on North American Pacific amphipods, in many ways, not the least of which was his generosity in supplying reprints of his pioneering work there.

Jerry Barnard's life-time impact on Pacific coast amphipod research was profound. His interest in amphipodology was multi-disciplinary. The results of his work continue to affect an increasingly wide circle of scientific colleagues, students, and the general public. He contributed voluminous new information not only on the taxonomy of amphipods, but also on their biogeography, ecology and , to some extent, on their life style and behaviour In this short summary we have attempted to high-light some particularly significant facets of his leadership qualities and creativity. Some colleagues mentioned here are relative newcomers to the world of amphipod research but all have benefitted significantly from his insights. In this tribute to Jerry, we

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have looked into details of selected research contributions in an attempt to assess the taxonomic breadth of his work, the etymology of his new taxonomic names, and his role in development of Pacific regional amphipod biogeography. This treatment may therefore appear a bit "diffuse" and perhaps unfocussed, but in this sense it reflects the diversity of Jerry Barnard's impact on Pacific science. We are deeply indebted to his legacy of new information and new ideas on Pacific am-phipods and grateful for his help in facilitating our own work in more northerly Canadian and S.E. Alaskan parts of that faunistically rich and scientifically challenging region.

ACKNOWLEDGEMENTS

This contribution results largely from our personal interaction with Jerry Barnard over the years. We wish to acknowledge helpful commentary on text material from colleagues at the J. L. Barnard memorial symposium in Washington in April, 1992, and from members of the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT), in Los Angeles, CA, where the paper was again presented in November, 1992. We thank P. G. Moore, Millport, Scotland., and Les Watling, Darling Marine Center, Walpole , Maine, for their editorial input on portions of the present text.

THE EASTERN NORTH PACIFIC STUDY REGION

The coastal marine northeast Pacific region, encompassing most of Jerry Barnard's faunistic study areas, may be subdivided, for convenience, into eight "working" sub-regions (see pertinent illustrations and Tables in Conlan and Bousfield (1982), Bousfield (1979b, 1982, etc.)). Clockwise around the North Pacific rim, from the left (as in TABLE III, p. 12) are: (1) the northwestern Pacific (Asiatic) coastal marine subregion; (2) Bering Sea and Aleutian Chain; (3) southern Alaska , Prince William Sound and southeastern Alaska; (4) north-central B. C. and Queen Charlotte Islands; (5) south-central B.C. and Vancouver Island; (6) Washington-Oregon; (7) north-central California; and (8) southern California and Baja California.. Zones 7 & 8 have been combined in the biogeographic subregions of Fig. 1, p. 11.

EARLY REGIONAL RESEARCH ACTIVITIES

Jerry Barnard's early interests in aquatic biology gave almost no clue as to his ultimate career obsession with amphipod crustaceans. His subsequent dedication and personal drive to develop the systematics, biogeography, ecology, and behaviour of these ubiquitous invertebrates was to influence the direction and scope of amphipodology as never before. Following his graduation from Pasadena Junior College in 1947, he took up a Ph.D. program at the University of Southern California, under the late Dr. John Garth, who gently steered him from a limited study of eastern Pacific corals towards amphipod crustaceans. In this challenging but initially frustrating, pursuit he was encouraged by the late R. J. (Bob) Menzies, an isopod specialist, with whom he shared early interests in marine wood-boring crustaceans. With the support also of Dr. John W. Mohr, USC professor, this interest led to a Ph.D. thesis on the wood-boring amphipod *Chelura terebrans,* published in 1955, and soon afterwards, a world-revison of the family (1959). In the concluding year of his thesis he gained initial experience with more northerly eastern Pacific amphipods at Coos Bay, Oregon (1954a). Following three summers' work (as a USC PDF) in arctic coastal marine regions (Pt Barrow, and Ice Island T-3) he returned to the balmy climes of Southern California where he began a major program as a research associate at the Beaudette Foundation, near Pt Conception. The Institute provided facilities which allowed him to penetrate coastal marine environments (especially sedimentary ones), to all depths, up and down the coast, but mainly into the sub-tropical environments, including the rich unexplored amphipod faunas of the Baja region. Contemporaneously, and in later years through participation in international marine expeditions, he pioneered the systematics of the rich unknown faunas of regional submarine canyons and of the deep-sea. Working virtually as a one-man-show, Jerry produced a flood of regional amphipod revisionary studies (1958-1964, and continuing), that established the taxononomic basis for all subsequent studies on amphipods of the Californian and (as his colleagues of today are finding) the entire North American Pacific region.

NORTH PACIFIC REGIONAL PUBLICATIONS

Jerry Barnard's contribution to knowledge of the North American Pacific gammaridean amphipod fauna has been monumental. Of his output of about 220 published papers worldwide (1950-1991: see Rothman, 1992), at least 65 papers (nearly 30%) deal solely or inclusively with the systematics, biogeography, ecology and behaviour of the N.E. Pacific fauna, mostly from Washington-Oregon to Baja California (sub-regions 6, 7, 8 (above)). About half the titles were produced during his active field work in the California-Oregon region from1947-1963 and the remainder during his residence in Arizona, 1964-74, and at the USNM in Washington, 1974 to 1991. Of these 65 titles, some 30% are short descriptive papers at species level, e.g.*Chelura terebrans* (1955); *Dogielinotus loquax,* (1967), and another 30% are larger monographic studies at genus or family level, e.g. Phoxocephalidae (1960); Synopiidae (1972); *Rhepoxynius* (with Charlene, 1982). About 15% are subregional faunistic studies, e.g. "Oregon amphipods" (1954a), "California rocky intertidal" (1969b) and another 15% reveal his special interest in the deep-water and bathyal species, e.g. "Submarine canyon amphipods" (1966), and "Cedros Trench" (1967a). The remaining 10% of titles (and by no means the least important) reflect Jerry's (and Charlene's) unrivalled talent as collators of voluminous

data, and include popular works such as "Light's Manual: Amphipoda" (1975); and taxonomic compendia such as "Index to Families, Genera, and Species" (1958); and "Families and Genera" (with Gordan Karman, 1991). This last served to update Jerry's previous alphabetically arranged single-author study (1969a) which, in itself, had replaced Sars (1895), Stebbing (1906) and Gurjanova (1951) as the modern taxonomic "Bible" of gammaridean amphipod research. Many of Jerry's studies on amphipod systematics contain detailed station data, and reveal deep interest in faunal ecological relationships. In his major synthesis with Charlene (1983), the coastal freshwater and terrestrial gammarideans are also treated.

PREVIOUS REGIONAL STUDIES

Prior to Jerry Barnard's initial studies on the Californian and southern Oregon coasts in 1947-54, relatively little work had been done on amphipods of any of these North American coastal marine sub-zones. Chief among a mere two dozen early regional studies were those of Dana and Stimpson in the mid-1800's (Puget Sound to California), S. J. Holmes in the first decade of this century (off Alaska and off S. California), Vimy Stout in 1913 (southern California), A. L. Alderman in 1936 (northern California), Elsa D. Thorsteinson in 1941 (N. Washington State region) and Clarence R. Shoemaker from 1926-1964 (throughout the region). The 19th century records had been encompassed in the major world-wide compendium of Stebbing (1906).

In recent years, and partly in response to Jerry's taxonomic leadership on the Californian fauna, including that of the SCAMIT group directly, the number of North American regional studies by others has more than doubled. More emphasis was placed on the previously unstudied coastal amphipods occurring in Alaska and British Columbia by D. E. Hur ley (1963), T. E. Bowman and J. C. McCain (1967), K. O. Coyle (1980-82), P. N. Slattery (1985-86), C. P. Staude (1987, and in prep.), P. G. Moore (1993), and by the "Canadian group" that includes E. L. Mills (1961-62), Diana R. Laubitz (1977), J. J. Dickinson (1982-83), Kathleen E. Conlan (1982-83, 1990), Norma E. Jarrett (1981, 1982, 1994), C.-t Shih (in prep.), E. A. Hendrycks (1994), Jane R. Kendall (in prep.), Andrée Chevrier (in prep.), Phillip Hoover (in prep.) and the present authors (1981-1994).

The northwestern Pacific gammaridean fauna, much of which overlaps, or is closely related to, the Northeastern Pacific fauna, had been well studied by Russian workers, mostly prior to Jerry's arrival on the scene. Among the most productive systematists were A. I. Bulycheva (1938, 1957); Eupraxie F. Gurjanova (1951, 1962, 1980); J. A. Birstein and M. E. Vinogradov (1958,) and, more recently, N. L. Tzvetkova (1975). Their work was complemented by the studies of Japanese gammaridean specialists such as M. Iwasa (1939), K. Nagata (1965, 1966), and more recently by H. Morino (1979), A. Hirayama (1983, 1986) and others.

In summary, we may gauge the overall impact of Jerry Barnard's publication record on the North Pacific amphipod fauna by noting that it exceeded that of all other workers of the Northeastern region combined (to date), and surpassed all previous work on the Northwestern Pacific fauna, which had been taxonomically broad in scope and extensive in time.

IMPACT OF TAXONOMIC NAMES PROPOSED BY J. L. BARNARD

An indicator of the magnitude of Jerry Barnard's scientific impact is the regional extent of his new taxonomic names. Analysis of these names is here based on the list of North American Pacific amphipod taxa published by Don Cadien on behalf of SCAMIT (1991). In Table I, the numbers of published regional amphipod genera and species are summarized by superfamily, family, and subfamily where applicable (column 1), according to the Cadien List, 1991 (column 2), and to an unpublished "Canada List" (column 3) that includes forthcoming taxa from northern regions of British Columbia, Alaska, and the Bering Sea. The individual sub-columns (of columns 2 and 3) give the ratio of taxa newly described by Jerry Barnard to the total number of that taxon known from the region. Thus, within the "genera" sub-column, a ratio of 4/20 means that Barnard originally described 4 of the 20 known regional genera within the perrtinent subfamily/family/superfamily category of column 1. Within the species sub-column, a ratio of 18/55 means that he originally described 18 of 55 species known from the pertinent larger taxon of column 1.

Although Barnard's listings and arrangements were almost invariably alphabetical, the arrangement of superfamilies here is phyletic, following Bousfield (1979, 1982, 1983, in prep.), and Schram (1986). Such permits a more natural (clearly related) grouping of families and a return to the semi-phyletic arrangements of Sars (1895) and Stebbing (1906). Those early amphipod systematists lacked knowledge of most of today's fauna and numerical taxonomic methodology, yet they were remarkably prescient in their quasi-phyletic arrangements. Following the lead of Don Steele (1988) who demonstrated that amphipods are primarily and primitively swimmers, and secondarily crawlers, burrowers, and tube-builders, we may apply the terms neritic-mating, and benthic-mating for corresponding amphipod superfamily groupings. These categories are roughly analogous to the terms "Natantia" and "Reptantia" that were utilized in earlier pragmatic classification of decapod crustaceans. These terms may be diagnosed briefly as follows (see also Bousfield, 1994, in prep):

"SWIMMERS": Swimming life style (essentially); sexes mate in the water column; mature male stage is terminal, often non-feeding; males are strongly dimorphic in sensory and swimming structures (i.e. possess antennal callynophore and/or brush setae and/or calceoli, and powerful pleopods and tail fan); telson is usually bilobate; gnathopods are usually not sexually dimorphic and not pre-amplexing in function.

TABLE I. NUMBERS OF AMPHIPOD CRUSTACEANS FROM THE NORTH EASTERN PACIFIC COASTAL MARINE REGION DESCRIBED BY J. L.BARNARD, 1952-1991.

TAXON	"SCAMIT LIST" (D. B. Cadien, S. Calif.)		"CANADIAN LIST" (ELB Research Group)	
A. "SWIMMERS" (natants)	Genera New/Total	Species New/Total	Genera New/Total	Species New/Total
I. PHOXOCEPHALOIDEA	7/16	37/56	8/19	37/76
1. Urothoidae	0/1	1/3	0/1	1/3
2. Phoxocephalidae				
Metharpiniinae	3/4	20/29	3/6	20/37
Parharpiniinae	1/1	0/2	1/1	0/2
Pontharpiniinae	1/1	0/1	1/1	0/3
Harpiniinae	0/4	11/13	0/5	11/19
Eobrolginae	1/2	2/4	1/2	2/8
Phoxocephalinae	1/2	2/3	1/2	2/3
Coxophoxinae	1/1	1/1	1/1	1/1
3. Platyischnopidae	2/2	2/2	-	-
II. PONTOPOREIOIDEA	1/2	1/6	1/4	1/11
1. Pontoporeiidae	0/1	0/1	0/3	0/4
2. Haustoriidae	1/1	1/5	1/1	1/7
III. LYSIANASSOIDEA	5/33	21/73	5/45	21/112
1. Uristidae	4/20	18/55	4/26	18/82
2. Lysianassidae	1/7	3/9	1/8	3/12
3. Cyphocaridae	0/3	0/6	0/4	0/8
4. Hyperiopsidae	-	-	0/2	0/3
5. Conicostomatidae	0/2	0/2	0/3	0/4
6. Trischizostomatidae	-	-	0/1	0/1?
7. Valettiidae	0/1	0/1	0/1	0/2
IV. EUSIROIDEA	3/12	10/32	10/56	10/54
1. Pontogeneiidae	1/3	3/14	1/3	3/16
2. Bateidae	0/1	0/2	-	-
3. Calliopiidae	2/4	3/5	2/6	3/12
4. Eusiridae	0/3	2/9	0/7	2/16
5. Gammaracanthidae	-	-	0/1	0/2
6. Amathillopsidae	-	-	0/1	0/1
7. Epimeridae	0/1	2/2	0/1	2/3
8. Paramphithoidae	-	-	0/3	0/4

TABLE I. (Cont'd - 2)

TAXON A. "SWIMMERS"	"SCAMIT LIST" (D.B. Cadien, S. Calif.)		"CANADIAN LIST" (ELB Research Group)	
	Genera New/Total	Species New/Total	Genera New/Total	Species New/Total
V. OEDICEROTOIDEA 1. Oedicerotidae	1/9	19/30	1/11	19/45
VI. SYNOPIOIDEA 1. Argissidae 2. Synopiidae	1/6 0/1 1/5	6/12 0/1 6/11	3/8 0/1 3/7?	10/17 0/2 10/15?
VII. PARDALISCOIDEA 1. Pardaliscidae 2. Stilipedidae	1/6 1/9 0/2	6/12 9/12 0/2	1/12 1/10 0/2	9/14 9/12 0/2
VIII. STEGOCEPHALOID. 1. Stegocephalidae	0/1 0/1	0/1 0/1	0/5 0/5	0/6 0/6
IX. HYPERIIDEA 1. Physosomata 2. Physocephalata	0 - -	0 - -	0/12	0/30
X. DEXAMINOIDEA 1. Atylidae 2. Lepechinellidae 3. Dexaminidae	1/5 0/1 0/1 1/3	3/8 1/4 1/1 1/3	1/5 0/1 0/1 1/3	3/13 1/8 1/1 1/4
XI. AMPELISCOIDEA 1. Ampeliscidae	0/3	19/52	0/3	19/55
XII. MELPHIDIPPOIDEA 1. Melphidippidae 2. Megaluropidae	3/5 1/3 2/2	6/6 3/3 3/3	6/6 1/3 2/2	 3/3 3/3
B. "CRAWLERS" (reptants)				
XIII. CRANGONYCTOIDEA 1. Crangonyctidae	-	-	0/3	0/5
XIV. TALITROIDEA 1. Hyalidae 2. Hyalellidae 3. Dogielinotidae 4. Najnidae 5. Talitridae 6. Phliantidae 7. Eophliantidae	1/13 0/2 0/2 0/1 0/1 0/5 0/1 1/1	8/28 3/6 1/5 1/1 1/2 0/12 1/1 1/1	1/17 0/6 0/2 0/1 0/1 0/5 0/1 1/1	8/73 3/30 1/8 1/1 1/10 0/12 1/1 1/1

TABLE I. (Cont'd - 3)

TAXON B. "CRAWLERS" (reptants)	"SCAMIT LIST" (D. B. Cadien, S. Calif.)		"CANADIAN LIST" (ELB Research Group)	
	Genera New/Total	Species New/Total	Genera New/Total	Species New/Total
XV. LEUCOTHOIDEA	6/24	**28/52**	6/49	**28/142+**
1. Pleustidae	**4/7**	**8/18**	4/30	8/80
Mesopleustinae	-	-	0/1	0/2
Eosymtinae	-	-	0/2	0/3
Pleusymtinae	1/1	2/2	1/6	2/14
Stenopleustinae	0/1	1/1	0/3	1/3
Pleustinae	0/1	1/5	0/3	1/28
Pleusirinae	1/1	1/1	1/1	1/1
Dactylopleust.	1/1	0/2	1/1	0/2
Pleustoidinae	-	-	0/1	0/1
Neopleustinae	-	-	0/4	0/4
Parapleustinae	1/2	**3/7**	1/7	3/22
2. Amphilochidae	0/3	**3/5**	0/5?	**3/8?**
3. Leucothoidae	0/1	1/2	0/1	1/4
4. Anamixidae ...	0/1	2/2	-	-
5. Stenothoidae	2/9	**13/22**	2/14?	**13/40+**
6. Lafystiidae	0/1	0/1	0/3	0/5
7. Acanthonotozomatidae (*s. l.*)	0/3	1/3	0/7	1/8
XVI. LILJEBORGIOIDEA	1/3	**7/10**	0/1?	0/1?
1. Liljeborgiidae	1/2	**7/9**	- ?	- ?
2. Sebidae	- ?	- ?	0/1	0/1
3. Colomastigidae	0/1	0/1	- ?	- ?
XVII. GAMMAROIDEA				
1. Gammaridae	0/1	0/1	0/2	0/2
2. Anisogammaridae	0/5	0/9	0/8	0/18
3. Mesogammaridae	0/1	0/1	0/1	0/1
4. Gammaroporeiidae	0/1	0/1	0/1	0/1
XVIII. HADZIOIDEA	**3/9**	12/24	1/8	**10/37?**
1. Hadziidae	**2/2**	**2/2**	- ?	- ?
2. Melitidae	1/7	**10/22**	1/8	**10/37 ?**
XIX. COROPHIOIDEA	7/39	**32/128**	7/51	**32/150**
1. Isaeidae	3/11	**16/50**	3/11	**16/55**
2. Ischyroceridae	2/6	**6/19**	2/7	**6/30**
3. Ampithopidae	0/3	3/18	0/4	3/22? .
4. Biancolinidae	1/1	**1/1**	1/1	1/1
5. Aoridae	1/10	3/18	1/10	3/18

TABLE 1.(Cont'd - 4)

6. Cheluridae	0/1	0/1	0/1	0/1
7. Corophiidae	0/1	0/9	0/1	0/10
8. Podoceridae	0/5	2/11	0/5	2/11
XX. CAPRELLIDEA				
1. CAPRELLIDA	-	-	0/10 ?	0/25+ ?
2. CYAMIDA	-	-	0/6 ?	0/10+ ?
XXI. INGOLFIELLIDEA* (unconfirmed record from Prince William Sound *fide* Cadien)				

"CRAWLERS": Life style mainly crawling,, burrowing,, domicolous, or inquilinous; mate on or in the bottom; mature male with indeterminate growth; males weakly or not dimorphic in sensory structures (i.e.lack callynophore calceoli, or brush setae, except in the most primitive crangonyctoideans and gammaroideans), with normal or weak pleopods and tail fans; telson lobes often fused to a simple plate; gnathopods strongly sexually dimorphic (usually), typically pre-amplexing and/or agonistic in function.

Highlights of Table I. Of the 513 published species listed by Cadien (1991) from S. California to Alaska, Jerry Barnard newly proposed 213 names (about 40% of the total). For ease of analysis, taxonomic groups in which Barnardian taxa are especially dominant or significant are indicated in **boldface.** The table reveals the following:

1. JLB described new taxa in 45/60 regional families and in all but 2 superfamilies of gammaridean amphipods. He did not include hyperiids, caprellids, or ingolfiellids in his regional studies.

2. JLB described about 50% more new taxa from the "natant" superfamilies (126) than from the "reptant" superfamilies (87) although total numbers of species within each group were roughly the same. This difference is probably a reflection of the greater taxonomic challenge among sediment-burrowing species that Jerry faced when he first arrived on the scene. This, in turn may have reflected the concentration of early taxonomic study on the relatively more conspicuous and more easily collected males of epifaunal and tube-dwelling amphipod groups.

3. JLB made major name contributions (ratios of 20- 50% +) in the reproductively "natant" (particularly infaunal or sediment-burrowing) groups such as Phoxocephaloidea, Lysianassoidea, Oedicerotoidea, Synopioidea, Ampeliscoidea, and Melphidippoidea, as well as the Eusiroidea and Pardaliscoidea..

Within the "reptants", JLB's strongest name contributions were in some Talitroidea (Hyalidae), some Leucothoidea (Pleustidae, Amphilochidae, and Stenothoidae), the commensal Liljeborgioidea, the Hadzioidea, and the relatively primitive families within the Corophioidea (Isaeidae, Ischyroceridae, and Ampithoidae). However, he contributed few new names to groups such as the Pontoporeioidea and Gammaroidea (northern and/or freshwater), Crangonyctoidea (freshwater), and talitroideans (semi-terrestrial).

5. The proportion of Barnardian new names is generally lower in taxonomic groups of the "Canadian" list, e.g., in some families of Talitroidea (Hyalidae, Hyalellidae, and Najnidae) and Leucothoidea (Pleustidae) which are proving to be mainly northern in distribution. However, little reduction of his impact is noted within the advan-ced corophioideans, many described previously, and not at all in the Liljeborgioidea, the families of which are almost exclusively southern in biogeographic affinities.

ETYMOLOGY OF NEW GENERIC NAMES BY J. L. BARNARD

Some interesting facets of Jerry Barnard's taxonomic work are revealed by his choice of new taxonomic names. Table II provides a list of all new generic and new family names proposed by Jerry and his co-authors in papers dealing with the North American Pacific gammaridean amphipod fauna. His 45 new generic names represent more than 20% of all those applied to the 500+ species of the SCAMIT regional list (Cadien, 1991). Of the two new family names, one (Najnidae) is apparently endemic to the North Pacific region. His leadership in the development of information on this unique group of talitroidean kelp borers is to be recognized in a forthcoming paper in this journal (Bousfield and Hendrycks, in prep).

Analysis of the etymology of names selected at the generic level reveals a shift in emphasis both temporally and regionally during Jerry's career. In the initial phases, as in the California-Oregon studies, his selection of names was essentially classical or typical. Thus, within the 45 genera of North American Pacific gammarideans containing species described by him, their root-sources may be apportioned thusly: classical Latin or Greek origin (10, or 23% of total); classical prefix-suffix modifications of existing root names (13, or 31%); anagrams (word scrambles) (12, or 28%); native, or aboriginal names (5, or 11%); miscellaneous origins (5, or 11%).

TABLE II. HIGHER TAXONOMIC NAMES OF NORTH AMERICAN PACIFIC GAMMARIDEAN AMPHIPODA PROPOSED BY J. L. BARNARD AND CO-AUTHORS 1950-91
(per D. B. Cadien, SCAMIT taxonomic list, 1991)

I. Superfamily PHOXOCEPHALOIDEA

Mandibulophoxus (gilesi) 1957
Coxophoxus (hidalgo) 1966
Eobrolgus (spinosus) 1979
Eyakia (calcarata) 1979
Foxiphalus (obtusidens) 1979
Grandifoxus (grandis) 1979
Rhepoxynius (epistomus) 1979
**Eudevenopus (honduranus) 1983*
**Tiburonella (viscana) 1983*

II. Superfamily PONTOPOREIOIDEA

Eohaustorius (washingtonianus) 1957

III. Superfamily LYSIANASSOIDEA
**Dissiminassa (dissimilis) 1991*
Ocosingo (borlus) 1969
Fresnillo (fimbriatus) 1969
Pachynella (lodo) 1964
Rimakoroga (rima) 1987
Thrombasia (viscalero) 1966

IV. Superfamily EUSIROIDEA
Accedomoera (vagor) 1964
Oligochinus (lighti) 1969
Calliopiella (pratti) 1954
Callaska (pratti) 1954

V. Superfamily OEDICEROTOIDEA
Finoculodes (omnifera) 1971

VI. Superfamily SYNOPIOIDEA
Garrosyrrhoe (bigarra) 1964

VII. Superfamily PARDALISCOIDEA
Tosilus (arroyo) 1966

VIII. Superfamily DEXAMINOIDEA
Dexamonica (reduncans) 1957

IX. Superfamily MELPHIDIPPOIDEA
Melphisana (bola) 1962
*MEGALUROPIDAE 1986
**Gibberosus (longimerus) 1986*
**Resupinus (syncaudatus) 1986*

X. Superfamily TALITROIDEA

NAJNIDAE 1972
Lignophliantis (pyrifera) 1969

XI. Superfamily LEUCOTHOIDEA
**Dactylopleustes (echinoicus)1979*

Pleusirus (secorrus) 1969
Pleusymtes (glaber) 1959
**Incisocalliope (newportensis) 1959*
Stenula (latipes) 1962

**Zaikometopa (erythrophthalma) 1987*

XII. Superfamily LILJEBORGIOIDEA.
Listriella (goleta) 1959

XIII. Superfamily HADZIOIDEA
Netamelita (cortada) 1969
Dulzura (sal) 1969
Lupimaera 1982 (lupana) 1969

XIII. Superfamily COROPHIOIDEA
Gaviota (podophthalma) 1958

Amphideutopus (oculatus) 1959
Chirimedeia (zotea) 1962
Cedriphotis (malinolea) 1967

Ventojassa (ventosa) 1970

Acuminodeutopus (heteruropus) 1959
Rudilemboides (stenopropodus) 1959

Note:

1. All names listed without regard for subsequent synonymy
2. *: co-authored names
3. TYPE species in parentheses

These proportionalities, in which classical selections comprise more than 50% of the names, contrast rather markedly with those of some later contemporary studies, especially on Australian and New Zealand faunas, where native or aboriginal became predominant. Thus, in his collaborations with Margaret Drummond (1978 et seq.), more than 75% of his new names can be attributed to such roots, but very few to classical origins. The pragmatic significance and usefulness of this change of emphasis remains to be assessed. However, at least a few authors (e.g. Fenwick, 1980; Thurston, 1982) have followed this lead.

BARNARDIAN IMPACT ON NORTHEASTERN PACIFIC AMPHIPOD BIOGEOGRAPHY

Jerry's Barnard's scientific impact on the amphipod fauna of British Columbia and Alaska is very significant, but is less striking than that on the Californian fauna. As one might expect this difference is undoubtedly a function of biogeographical factors within the regional faunules, combined with Jerry's field involvement mainly with the Californian biota.. The overall basis for such a correlation is provided in an overview of the principal coastal marine biogeographical sub-regions from Alaska to Central California (Figure 1), as originally demonstrated by Jarrett, Hendrycks, and Bousfield (1989). The biogeographical affinities of northeastern Pacific amphipods may be clustered into two major subgroupings: (1) those with arctic-subarctic affinities that penetrate variiously southwards to summer-warm limits of survival, and (2) those with boreal and warm-temperate affinities that penetrate variously northward to summer-cold limits of reproductive capability. A few warm-temperate species common in southern California (TABLE I, zone 8) also occur disjunctly in the Strait of Georgia (zone 7 of map). A small enclave in the region from about Dixon Entrance to Cross Sound (southeastern Alaska), termed the N. E. Pacific High Boreal subregion, contains species that occur exclusively there or in closely adjacent waters (zone 5 of map).

It appears from this preliminary biogeographical analysis that a large percentage of the total northeastern Pacific coastal marine fauna terminates in the Alaska-B.C. region and does not reach California. By contrast, although a significant fraction of the Californian fauna reaches British Columbia, it terminates at southeastern Alaska.. For this reason, therefore, Jerry Barnard, working mainly from Oregon southward to Baja California, treated the northern fauna in a peripheral manner. Although he left a major taxonomic challenge for the current Canadian group of amphipod systematists, he did provide numerous published examples of how it might be undertaken.

A detailed basis for the above biogeographic correlation of Barnard's N. American Pacific work is encapsulated in Jarrett and Bousfield's recent treatment of the regional phoxocephlid subfamily Metharpininiinae, (this volume, p. 58). Career-wise, the infaunal Phoxocephalidae was perhaps Jerry"s single most intensively studied family

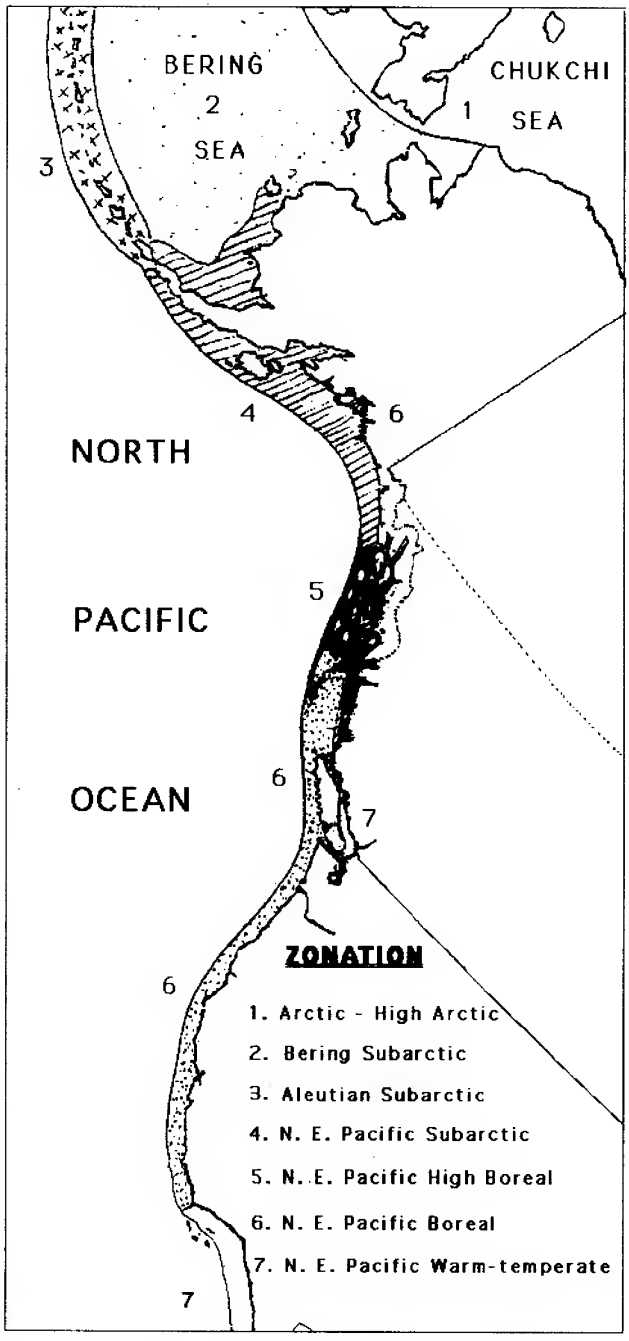

FIG.1. Coastal Biogeographical Sub-Regions

group . In Table III, the distribution of 43 N. American Pacific species within the Metharpiniinae is plotted across 8 subregions from the northwestern Pacific to Baja California. In general we may note that the most primitive species and genera (within *Grandifoxus* and *Beringiaphoxus)* are confined to the most northerly zones, the most advanced species and genera (within *Rhepoxinius* and *Metharpinia)* occur in the south (zones 4-8) and phyletically intermediate species (within *Majoxiphalus* and *Foxiphalus)* are clinally intermediate throughout.

Remarkably, Jerry Barnard is the author of half (3/6) of the regional generic names (as well as half the species within the southerly genus *Microphoxus*), and slightly more than

TABLE III. DISTRIBUTION OF NORTH AMERICAN PACIFIC METHARPIINAE.
(* Barnardian named taxa)

SPECIES	NORTH PACIFIC SUBREGION							
	1	2	3	4	5	6	7	8
I. *GRANDIFOXUS**								
robustus	X							
westi	**X**							
constantinus		X						
pseudonasutus		X						
nasutus		X						
vulpinus		X	x					
aciculatus		X	x	?				
acanthinus		X	X					
lindbergi	X	X	X	**X**	**X**			
longirostris		X	X	X	X			
dixonensis				X				
grandis			X	X	X	X		
II. *BERINGIAPHOXUS*								
beringianus		**X**						
III. *MAJOXIPHALUS*								
maximus		X	X	X	x			
*major**			x	X	X	X	x	
IV. *FOXIPHALUS**								
*aleuti**		X						?
slatteryi		X						
*similis**			x	X	X	X	X	
*xiximeus**			**X**	X	X	X	X	X
fucaximeus						**X**		
falciformis				X	X	X		
obtusidens						x	**X**	**X**
*cognatus**								**X**
*golfensis**								**X**
*apache**								**X**
*secasius**								**xS**
V. *RHEPOXYNIUS*								
*pallidus**				X	X	x		
*vigitegus**				X	X	X		
boreovariatus				**X**	X	X		
*fatigans**				X	X	X	X	x
*daboius**				x	?	X	X	X
*variatus**				X	?	?	x	X
*abronius**				X	X	X	X	X
barnardi					**X**	**?**		
*tridentatus**					X	?		
*bicuspidatus**						x	X	x
*lucubrans**							x	X
*stenodes**							?	X
*homocuspidatus**								X
*heterocuspidatus**								X
*menziesi**								xS
*gemmatus**								xS
VI. *METHARPINIA*								
*jonesi**								X
VII. *MICROPHOXUS**								xS

LEGEND FOR TABLE III.

I. Occurrence

X - abundant in region (or presumed so)

x - marginally in region.

xS - essentally south of this region (tropical)

II. Coastal Regions (Progression: North-west to South-east)

1. Japan Sea and Western Pacific
2. Bering Sea and Aleutian Chain to Kodiak I.
3. Prince William Sound & South-eastern Alaska (N. of Dixon Entrance.)
4. North central B. C. coast and Queen Charlotte Ids.
5. Southern B.C. coast and Vancouver Island.
6. Washington and Oregon
7. Northern and Central California
8. Southern and Baja California

half (23/43) of the total species within subfamily Metharpiniinae throughout this 8000-mile coastal continental region. On closer examination, we may note that he named 87% (14/16) of species in the most southerly large genus *Rhepoxynius* and 93% of all species (of 5 genera) that range into California. By contrast, he named only 10% (2/20) of species that do not occur in California, and none in the most northerly genera, *Grandifoxus* and *Beringiaphoxus*.

From this example we might expect a similar north-south distribution of Barnardian nomenclatural influence within other major gammaridean taxa, especially those having relatively strong geographical endemism of both species and genera. Such indications have already been noted by one of us (ELB, in preparation) within the Pleustidae, the Melitidae, and some Talitroidea..

QUALITY OF REGIONAL GUIDES AND KEYS

An especially noteworthy feature of Jerry's impact on students of amphipod crustaceans is the exemplary quality of his popular guides and illustrated reference compendia. His chapter on gammaridean amphipods in Light's Manual (1975) remains one of the most useful and best illustrated guides of its type. The keys consist of simple one (or two-) character couplets for which the pertinent illustrations are clear, and the lines clean and uncluttered. The illustrations of his monographic studies and compendia, especially after 1963, are characteristically clean, and the format simple, and provide ample space between individual figures within the plate. These are identified by referenced symbols of a complexity endemic to his own publications. Illustrations of series of mouthparts, gnathopods, telsons, and other taxonomic characters permit ready comparison of critically distinctive character states that are difficult to envisage from the text alone.

Barnard's textual accounts underwent an evolution from generality and brevity in early papers,e.g. Oregon amphipods (1954), to highly specific, and perhaps overly detailed, voluminous descriptions in later monographs (e.g. *Rhepoxyxinius* , 1982). To date, relatively scant diagnostic or numerical phyletic use has been made of many of these character states, either by Jerry or by others. However, he literally left few stones unturned in revealing species taxonomic characters, many previously unnoticed, of possible or potential significance to future amphipod systematists. His originality in coining new descriptive epithets, many of which are now acceptably standard in the discipline, has been noted in other tributes paid to Jerry at the Washington symposium (e.g. by Tom Bowman and Rick Brusca).

We may conclude here by noting that Jerry Barnard's illustrated compendia have facilitated the introduction of at least two generations of students to North American Pacific amphipods. They have proved an exemplary model for Craig Staude's later regional illustrated key (in Kozloff, 1987; see below). Unquestionably also, his impact will continue to be amplified by forthcoming and future illustrated guides, including that planned by Craig and myself, as outlined in the Washington symposium.

CONCLUDING TRIBUTES TO J. L. BARNARD.

Jerry Barnard's leadership in North American Pacific Amphipodology has had a profound and lasting impact, both professionally and personally, on contemporary regional faunal workers. This effect is perhaps most appropriately encapsulated in the personal tribute provided by one of us (CPS), which is our privilege to include here:

"Shortly after I entered graduate school at the University of Washington in 1974, I was faced with the task of identifying amphipods from Puget Sound as part of a large project to assess the impact of Seattle's sewage treatment facilities. It soon became obvious that nearly all of the publications that would shed light on that fauna were the work of Jerry Barnard. His "Amphipods of Oregon", "Amphipoda" in "Light's Manual" (1975, 2nd edition), "Rocky Intertidal Amphipoda of California", Pacific Naturalist series, Allan Hancock papers, and, of course, his "Families and Genera"(1969) became the text-books for my self-taught class in amphipod identification. I also fell heir to the specimens and personal communication he had exchanged with John A. Houghton, a graduate student who preceded me in the College of Fisheries. Once I had developed sufficient confidence, I wrote to Jerry, who kindly responded to my many sophomoric questions.

The serendipitous events that brought me to Friday Harbor Laboratories and insured that I would focus my career on amphipods, also hinged on Jerry's work. I had heard of a "barrel" of specimens from the Pacific Northwest, which Jerry had identified, collecting dust at the Lab. I was eager to examine this collection to confirm my Puget Sound material, so I arranged a visit. During our brief stay, my wife Krispi and I organized the specimens in a manner that impressed its caretaker, Carl Nyblade. Carl offered both of us jobs in his baseline survey project, and we shortly moved to Friday Harbor.

While at Friday Harbor, I decided to pursue a PhD, examining the systematics and biology of amphipods. In this doctoral research, I was again generously assisted by Jerry Barnard. He invited me to work in the visitors' lab at the Smithsonian during two brief visits to the east coast. We discussed my work, and he offered hard-to-find references for me to photocopy. In preparing my keys to the Gammaridea for Kozloff's (1987)"Marine Invertebrates of the Pacific Northwest", Jerry permitted me to use several of his earlier illustrations, and offered helpful advice. I continued to receive reprints of his valuable publications up until his passing.

In short, my life would be very different, and I believe less rewarding and enjoyable, were it not for the impact of Jerry Barnard. My career and even my home have been affected by his life. I would like to add my thanks to the many tributes offered at the meeting in Washington."

In conclusion, we feel certain that Craig's tribute to Jerry Barnard is warmly echoed by all members of the "Canadian Working Group" of amphipod systematists. These include present staff members of the Canadian Museum of Nature in Ottawa: Mark Shih, Diana Laubitz, Kathleen E. Conlan, Ed Hendrycks, and Fahmida Rafi; taxonomic associates of the CMN: Norma Jarrett, and Jane Kendall, both of Ottawa; John Dickinson, Kingston, PA; Andree Chevrier, and Marjorie Bousfield, Montreal, Que.; Patrick Shaw, Regina, Sask.; Eric Mills, Halifax; N.S.; Phillip Hoover, Victoria, B.C.; Craig Staude, Friday Harbor Laboratories, WA, USA; P. G. Moore, Scotland; Gordan Karaman, Yugoslavia; Hiroshi Morino, Japan; and zoological illustrators Susan Laurie-Bourque, Hull, Quebec, and Floy E. Zittin, Cupertino, California. All of these workers have benefitted greatly from Jerry's professional taxonomic leadership and,published record which he has shared most generously with everyone concerned. Their appreciation of his contribution to North American Pacific Amphipodology and to the success of their own work can never be fully expressed. It will be reflected, however, at least in token manner, by several "Barnardian" patronyms, many planned for inclusion in subsequent issues of this journal, to be added to those already in his honour listed by Jim Thomas (1993).

LITERATURE CITED

(All J. L. Barnard references are given in J. D. Thomas' "Brief History of J. Laurens Barnard (1928-1991), and Bibliography", including an abbreviated summary of N.. American Pacific faunistic references (Table III),and in Rothman (1993).

Alderman, A. L., 1936. Some new or little known amphipods of California. Univ. Calif. Publ. Zool. 41: 53-74. 51 figs.

Barnard, J. L., 1950. The occurrence of*Chelura terebrans* Philippi in Los Angeles and San Francisco Harbors. Bull. So. Calif. Acad. Sci. 49:90-97.

————, 1954a. Marine Amphipoda of Oregon. Oregon State Monographs, Stud. in Zool., 8: 1-103.

————, 1954b. Amphipoda of the family Ampeliscidae collected in the eastern Pacific Ocean by the Velero IV. Allan Hancock Pacific expeditions, 18: 1-137.

————, 1955. The wood-boring habits of *Chelura terebrans* Philippi in Los Angeles Harbor. Essays in Natural Science in Honor of Captain Allan Hancock: 87-98, 2 pl. Allan Hancock Foundation, University of Southern California..

————, 1958. Index to the Families, Genera, and Species of the Gammaridean Amphipoda (Crustacea). Occ. Pap. Allan Hancock Foundation. Publ. 19: 1-145.

————, 1959. Generic partition in the amphipod family Cheluridae, marine wood borers. Pacif. Nat. 1(3): 1-2, 5 figs.

————, 1960. The amphipod family Phoxocephalidae in the eastern Pacific Ocean, with analyses of other species and notes for a revision of the family. Allan Hancock Pacific Expeditions, 18: 175-368.

————, 1966. Submarine Canyons of southern California ,Part V, Systematics: Amphipoda. Allan Hancock Pacific Expeditions, 27(5): 1-166.

————, 1967a. Bathyal and Abyssal gammaridean Amphipoda of Cedros Trench Baja Californ. Bull U. S. Natl. Mus. 260:1-205

————, 1967b. New and old dogielinotid marine Amphipoda.. Crustaceana, 13: 281-291.

————, 1969a. The families and genera of marine gammaridean Amphipoda. Bull. U.S. Natl. Mus. 271: 1-535.

————, 1969b. Gammaridean Amphipoda of The Rocky Intertidal of California: Monterey Bay to La Jolla.. Bull. U. S. Nat. Mus. 258:1-230.

————, 1972. A review of the family Synopiidae (= Tironidae), mainly distributed in the deep sea (Crustacea: Amphipoda). Smiths. Contr. Knowl. 124: 1-94.

————, 1975. Amphipoda: Gammaridea, pp. 313-366, pls. 70-85. In R. I. Sm ith and J. T. Carlton (eds). Light's Manual: Intertidal Invertebrates of the Central California Coast, 3rd. ed. 716 pp. Berkeley, Los Angeles, and London: Univ. California Press.

———— & C. M. Barnard, 1982. The genus *Rhepoxynius* (Crustacea: Amphipoda: Phoxocephalidae) in American seas. Smiths. Contr. Knowl. 357: 1-49.

———— ————, 1983. Freshwater Amphipoda of the World. I. Evolutionary patterns, and II. Handbook and bibliography. xix + 830 pp. 50 figs., 7 graphs, 98 maps, 12 tables. Hayfield Assoc., Mt. Vernon, Virginia..

& M. M. Drummond, 1978. Gammaridean Amphipoda of Australia, Part III: the Phoxocephalidae. Smiths. Contr. Zool. 245:1-551.

———— & G. S. Karaman, 1991. The Families and Genera of Marine Gammaridean Amphipoda (Except Marine Gammaroids) Parts I & II. Rec. Austral. Mus.,

Suppl. 13: 1-866.

Birstein, J. A. & M. E. Vinogradov, 1955. Pelagicheskie gammaridy (Amphipoda, Gammaridea) Kurilo- Kamchatskoi Zapadiny. Akad. Nauk SSSR, Inst. Okeanol. Trudy 12: 210-287.

————————————, 1958. Pelagicheskie gammaridy (Amphipoda, Gammaridea) severnozapadnoi chasti Tikogo Okeana. Akad. Nauk SSSR, Inst. Okeanol. Trud. 27: 219-257.

Bousfield, E. L., 1979a. A revised classification and phylogeny of amphipod crustaceans. Trans. Roy. Soc. Canada 4: 343-390.

————————, 1979b. The amphipod superfamily Gammaroidea in the northeastern Pacific region: systematics and distributional ecology. Bull. Biol Soc. Washington 3: 297-359.

————————, 1981. Evolution in North Pacific coastal marine amphipod crustaceans. in "Evolution Today". Proc. Int. Congr. System. Evol. Biol.: 69-89. 18 figs.

————————, 1982. The amphipod superfamily Talitroidea in the northeastern Pacific region. I. Family Talitridae: Systematics and Distributional Ecology. Natl. Mus. Nat. Sci., Publ. Biol Oceanogr., No. 11.: 1-73.

————————, 1983. An updated phyletic classification and palaeohistory of the Amphipoda. Crust. Issues 1: 257-78.

, 1987. Amphipod Parasites of Fishes of Canada. Can, Bull. Fish. Aqu. Sci. 217: 1-37, 10 figs.

———————— ,(in prep.). The Phyletic Classification of Amphipod Crustaceans: Problems in Resolution. Proc. First. Europ. Crustacean Conf. Mus. Natl. Hist. Natur. Paris. 40 pp. for AMPHIPACIFICA.

———————— & N. A. Jarrett, 1981. Station Lists of Marine Biological Expeditions of the National Museum of Natural Sciences in the North American Pacific Coastal Region, 1966 to 1980. Syllogeus No. 34: 1-66.

———————— & E. A. Hendrycks, 1994. A Revision of the family Pleustidae (Crustacea: Amphipoda). Part I. Systematcs and Biogeography of Component Subfamilies. AMPHIPACIFICA I(1):18 - 57.

———————— & H. Morino, 1992. The Amphipod genus *Ramellogammarus* (Amphipoda:Anisogammaridae) on the Pacific coast of North America. Contr. Royal B. C. Mus. No. 17: 1-22.

———————— & A. Chevrier, (in prep). The amphipod family Oedicerotidae on the Pacific coast of North America. Parts I & II. (for AMPHIPACIFICA).

———————— & Jane Kendall, (in prep). The amphipod superfamily Dexaminoidea on the Pacific coast of North America. Families Atylidae, Lepechinellidae, and Dexaminidae. (for AMPHIPACIFICA).

Bowman, T. E. & J. C. McCain, 1967. Variation and Distrib ution of the pelagic amphipod *Cyphocaris challengeri* in the northeast Pacific Ocean. (Gammaridea: Lysianassidae) Proc. U. S. Natl. Mus. 122: (3588): 14 pp.

Bulycheva, A. I., 1936. New Species of Amphipoda from the Japan Sea. Ann. Mag. nat. Hist., ser. 10. 18: 242 - 256. 35 figs.

————————, 1957. Morski blochi morei SSSR i sopredel'nyx Vod (Amphipoda-Talitroidea).Akad. Nauk SSSR Opred. po Faune SSSR 65: 1-185.

Cadien, D. B., 1991. List of the Marine Amphipod faunas of theTemperate and Boreal Northeastern Pacific Ocean including literature records of ocurrence between Bahia San Quintin, Baja California, and the south side of the Aleutian Islands, incorporating nomenclatural changes listed in Barnard & Karaman, 1991. SCAMIT tech publication, Sept. 1991, 21 pp.

Conlan, K. E., 1983. The amphipod family Corophioidea in the northeastern Pacific region. 3. Family Isaeidae. Publ. Biol. Ocean., Natl. Mus. Can., 4: 1-75, 36 figs.

,1990.Revision of the crustacean amphipod genus *Jassa* Leach. Can. Jour. Zool. 68: 2031-2075.

———————— & E. L. Bousfield, 1982. The amphipod superfamily Corophioidea in the northeastern Pacific region. Family Ampithoidae: Systematics and Distributional Ecology. Publ. Biol. Oceanog., Natl. Mus. Can.10 : 41-75.

Coyle, K. O., 1980. A new genus and species of Oedicerotidae (Crustacea: Amphipoda) from southeast Bering Sea. Syesis 13: 197-204.

———————— , 1982. The amphipod genus *Grandifoxus* Barnard (Gammaridea, Phoxocephalidae) in Alaska. Jour. Crust. Biol. 2: 430-450.

Dana, J. D., 1856. Catalogue and description of Crustacea collected in California by Dr. John L. Le Conte. Proc. Phil. Acad. Nat. Sci. 7: 175-177.

Dickinson, J. J., 1982. The Systematics and Distributional Ecology of the family Ampeliscidae (Amphipoda Gammaridea) in the North eastern Pacific region. I. The genus *Ampelisca* . Publ. Biol. Oceanogr., Natl. Mus. Canada 10:1-39.

————————, 1983. Ibid. II. The genera B*yblis* and *Haploops*. Publ. Nat.Sci., Natl. Mus. Nat. Sci 1: 1-38. 17 figs.

Fenwick, G. D.,1983. Two new sand-dwelling amphipods from Kaikoura, New Zealand (Oedicerotidae and Lysianassidae). New Zealand Jour. Zool. 10: 133-146.

Gurjanova, E. F.,1951. Bokopolvy Moreii SSSR i sopredel'nykh vod (Amphipoda- Gammaridea). Akad. Nauk SSSR, Opred. po Faune SSSR 41: 1-1029.

————————, 1962. Bokoplavy severnoi chasti Tikoga Okeana (Amphipoda Gammaridea. chast'1. Akad.Nauk SSSR. Opred. po Faune SSSR 74: 1-440, 143 figs.

————————, 1980. Some new data in the taxonomy of family Phoxocephalidae sensu lato (Amphipoda, Gammaridea). Rept. I. Akad. Nauk. SSSR. Zool. Inst.Issled. Fauny Morei 21 (29): 67-87.

Hirayama, A., 1983. Taxonomic studies on the shallow-water gammaridean Amphipoda of West Kyushu, Japan. I. Acanthonotozomatidae, Ampeliscidae, Ampithoidae, Amphilochidae, Argissidae, Atylidae, and Colomastigidae. Publ. Seto Mar. Biol. Lab. 28: 75-150.

————, 1986. Ibid. VI. Lysianassidae (*Orchomene*); Megaluropid family group, Melitides. Ibid. 31: 1-35.

Holmes, S. J., 1904. Amphipod crustaceans of the expedition; Harriman- Alaska Expedition : 223-246. 10 fig.

————, 1908. The Amphipoda collected by the United States Bureau of Fisheries Steamer "Albatross", off the west coast of North America in 1903 and 1904. Proc. U. S. Natl. Mus. 35: 489-543.

Hurley, D. E., 1963. . Amphipoda of the family Lysianassidae from the west coast of North and Central America. Allan Hancock Foundation Publ., Occ. Pap. 25: 1-165, 49 figs.

Iwasa, M., 1939. Japanese Talitridae. Jour. Fac. Sci., Hokkaido Imp. Univ., Zoology, ser. 6, 6: 225-296.

Jarrett, N. E., & E. L. Bousfield, 1982. Studies on the amphipod family Lysianassidae of the northeastern Pac-ific region. *Hippoomedon* and related genera: Systematics and Distributional Ecology. Natl. Mus. Nat. Sci.,Publ Biol. Oceanogr. **10**: 103-128, 9 figs.

—— ————, 1994. The amphipod superfamily Phoxocephaloidea on the Pacific coast of North America. Family Phoxocephalidae. Part I. Metharpiniinae, new subfamily. AMPHIPACIFICA I (1): 58-142.

———— E. A. Hendrycks & E. L. Bousfield, 1989. Studies on Amphipod Crustaceans of the Northeastern Pacific coastal marine regions: Calliopiidae and Phoxocephalidae. Ann. Meeting, Canadian Museum of Nature, November, 1989. Oral presentation. MS, 30 pp.

Laubitz, D. R., 1977. A revision of the genera *Dulichia* Kroyer and *Paradulichia* Boeck (Amphipoda: Podoceridae). Can. Jour. Zool. 55: 942-982. 20 figs.

Mills, E. L., 1961. Amphipod crustaceans of the Pacific coast of Canada, I. Family Atylidae. Natl. Mus. Can. Bull. 172: 13-33. 4 figs.

————, 1962. Ibid. II. Family Oedicerotidae. Nat. Hist. Pap., Natl. Mus. Can. 15: 1-21, 6 figs.

Moore, P. G., 1993. A study on amphipods from the superfamily Stegocephaloidea Dana 1852 from the north eastern Pacific region: systematics and distributional ecology. Jour. Nat. Hist. 26: 905-936.

Morino, H., 1979. Preliminary Report on the gammaridean Amphipoda around Sesoko Island. Tech. Rept. Sesoko Mar. Sci. Lab., 23: 179-189. 8 figs.

Nagata, K., 1965. Studies on marine gammaridean Amphipoda of the Seto Inland Sea. I. Publ. Seto Mar. Biol. Lab. 13: 131-170. 15 figs.

————, 1966. Ibid. IV. Ibid. 13: 327-348, 4 figs.

Sars, G. O., 1895. Amphipoda. An account of the Crustacea of Norway. 1: 711 pp., 240pl., 8 suppl. pl., Christiana, Norway.

Rothman, P. L. , 1993. New families ,genera and species of amphipod crustaceans described by J. Laurens Barnard (1928-1991). Jour. Nat. Hist. 27: 743-780.

Schram, F. R., 1986. Crustacea. Oxford University Press, New York. 1-606, 250+ figs.

Shoemaker, C. R.,1934. Two new species of *Corophium* from the west coast of America. Jour. Wash. Acad.Sci. 24: 356-360. 2 figs.

————, 1949. The amphipod genus *Corophium* on the west coast of America. Jour. Wash. Acad. Sci. 39: 68-82, 8 figs.

————, 1955. Amphipods collected at the Arctic Laboratory, Office of Naval Research, Point Barrow, Alaska, by G. E. McGinitie. Smiths. Misc. coll. 128 (1): 1-78, 20 figs.

————, 1964. Seven new amphipods from the west coast of North America, with notes on some unusual species. Proc. U. S. Natl. Mus. 115: 391-430.

Slattery, P. N., 1985. Life histories of infaunal amphipods from subtidal sands of Monterey Bay, California. Jour. Crust. Biol., 5 (4): 635-649.

————, & J. S. Oliver, 1986. Barnacle settlement on *Pleustes panopla tuberculata* (Amphipoda) in the Chukchi Sea. Jour. Crust. Biol. 7(2): 358-363.

Staude, C. P., 1987. Amphipoda. pp. 346-391. in E. N. Kozloff. "Marine Invertebrates of the Pacific North west". Univ. Wa. Press., Seattle. 511 pp.

Steele, D. E., 1988. What is the amphipod life style? Crustaceana, Suppl. 13. Studies on Amphipoda. 134-142.

Stimpson, W., 1856. On some Californian Crustacea. Proc. Calif . Acad. Sci., 1: 87-90.

————, 1864. Descriptions of new species of marine Invertebrata from Puget Sound, collected by the naturalists of the North-west Boundary Commission,A. H. Campbell, esq. commissioner. Proc. Acad. Nat. Sci. Philadelphia, 16: 153-165.

Stout, V. R., 1913. Studies in Laguna Amphipoda. Zool. Jahrb. Systematik 34: 633-659, 3 figs.

Stebbing, T. R. R., 1906. Amphipoda. I. Gammaridea. Das Tierreich 21. 1-806.

Thomas, J. D., 1992. J. Laurens Barnard (1928-1991). A Brief History, and Bibliography. Jour. Crust. Biol. 12(2): 324-326.

Thorsteinson, Elsa D., 1941. New or noteworthy amphipods from the North Pacific Coast. Univ. Washington, Publ. Oceanogr. 4: 50-96, 8 pl .

Thurston, M. H., 1982. *Cheus annae,* new genus, new species, (Cheidae, new family), a fossorial amphipod from the Falkland Islands. Jour. Crust. Biol. 2(3): 410-419.

Tzvetkova, N. L., 1975. Pribezhnye gammaridy severny kh I dal' nevostochnykh morei SSSR i sopredel'nykh vod. Akad. Nauk SSSR, Zool. Inst., Izdatel. "Nauka", Leningrad. 1-256, 89 figs.